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Irrigation Branch Experiment Station
Division of Agronomy

The Production of Cereals Under Irrigation in Washington

by

H. P. Singleton

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[1]In cooperation with the State Committee on the Relation of Electricity to Agriculture.
[2]In cooperation with the United States Department of Agriculture.
[3]In cooperation with Chelan County.
[4]Resigned June 1, 1930

SUMMARY

1. There are approximately 3,000,000 bushels of cereals grown under irrigation in the State of Washington each year.

2. At least 75 per cent of the total tonnage of the irrigated cereals is spring wheat, approximately 10 per cent barley, 8 per cent oats and 7 per cent, or less, winter wheat.

3. Spring wheat outyields all other cereals in pounds of grain per acre.

4. If winter wheat is desired Hybrid 128, Hybrid 123, Albit or Ridit may be used.

5. Winter barley has proven to be a very poor crop for growing under irrigation.

6. Jenkin, Dicklow and White Russian are high yielding varieties of spring wheat for the lower valleys.

7. These varieties and Federation had about the same value in Kittitas county in 1929. The early maturity and short straw of Federation are probably responsible for its wide use in that county.

8. Markton, Banner and Victory oats yielded the same. The smut resistance of Markton makes it the most desirable variety.

9. The high yielding barley varieties were Trebi, Blue and Beldi Giant.

10. Fertile soil is necessary for high yields of cereals.

11. Cereal crops give best results when sown early.

12. Satisfactory rates of sowing for the cereals are: wheat two bushels per acre, barley 100 pounds, and oats 100 pounds.

13. Spring cereals should be sown to a good depth in a firm, moist seed bed.

14. Ditching for irrigation should be done immediately after sowing.

15. Cereals should never be sown in soil which is so dry that it will ave to be irrigated before the plants emerge. If sowing is done late ıe land should be irrigated before sowing.

16. Cereals are not heavy users of water but respond readily to irigation.

17. Time of irrigation is determined by soil moisture and condition of the plant.

18. Cereals have a place on irrigated farms. They conserve water for other crops, are good nurse crops and furnish a large quantity of feed for live stock.

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THE PRODUCTION OF CEREALS UNDER IRRIGATION IN WASHINGTON

By H. P. Singleton

INTRODUCTION

The production of cereal crops under irrigation in Washington is much more extensive than is generally realized. The total production of wheat, oats and barley in 1928 on six of the irrigation projects in the Yakima Valley amounted to 1,454,248 bushels (1). A summarized report (2) of data furnished by dealers and shippers in Kittitas County showed that there were 902,400 bushels of cereals marketed in that county in 1927. Probably 90 per cent of this was grown under irrigation. No record was found regarding the amount of grain fed on the farm but there is little doubt that it exceeded the quantity of cereals grown without irrigation. With a total of over 2,357,000 bushels reported from these seven projects it appears that 3,000,000 bushels is a conservative estimate of the cereals which are grown annually under irrigation in this State. The new Kittitas High Line will bring about a material increase in the production in Kittitas County. As other projects are developed there will be a further increase in the total quantity of cereals grown under irrigation in the State.

Soon after the establishment of the Irrigation Branch Experiment Station at Prosser a study of some of the problems of cereal production was begun. From one to eight years results on the various problems are now available and these results form the basis for this bulletin.

EXPERIMENTAL METHODS

Except as noted, all the data reported herein were obtained on the Irrigation Branch Experiment Station which is located 4.5 miles northeast of Prosser, Washington. The elevation at the station varies from 800 to 890 feet. The average rainfall during the time of the experiments was approximately 7 inches per year.

(1) Annual Crop Census, 1928 Bureau of Reclamation, Wapato, Sunnyside, Satus, Ahtanum, Tieton and Toppenish-Simcoe Irrigation Projects.
(2) W. O. Passmore, County Agent, Information to the author.

Investigations of cereal varieties were started in 1922, using plots either in duplicate or triplicate during the entire series, according to the following detail:

1. Seeding: Six foot Kentucky drill.
2. Size: Length to make 1-40 acre after removal of borders and alleys just previous to harvest.
3. Alleys: One foot wide between plots.
4. Irrigation: Two furrows for each plot and one in the alley, (One furrow every 28 inches); three to four applications to provide continuous growth.
5. Cutting: Six foot Deering binder.
6. Threshing: No. 2 Ellis Keystone thresher.
7. Yield data: Sheaf and grain weights.

In nursery work triplicate rod rows 18 inches apart were used. Since the alleys between series were 2 feet wide, the dimensions of the area used in computing the yield of each row was 1.5 feet by 18.5 feet or 27.75 square feet.

EXPERIMENTAL RESULTS

Comparative Yields of the Various Cereals

A further examination of the data (1) and (2) from the seven irrigation districts previously mentioned showed that 82 per cent of the total tonnage of grain reported was wheat, 10 per cent barley and 8 per cent oats. The winter wheat was not segregated from the spring but it can be safely estimated at less than 10 per cent of the wheat reported. Then approximately 75 per cent of the total grain crop was spring wheat.

In order to study the relative adaptability of the various cereal crops to irrigation the annual yield of one of the leading varieties of each cereal is shown, in pounds per acre, in Table 1. Since yields were not obtained for all these varieties every year the comparative production of each is shown in percentage of yield of Jenkin spring wheat.

Table 1. Comparative Yield of Winter Wheat, Winter Barley, Spring Wheat, Spring Barley and Oats, Using a leading variety of each and using Jenkin Spring Wheat as a Standard for Comparison

Name of cereal and variety	Yield in pounds per acre								No. Yrs. grown	Comp'rtive production	
	1922	1923	1924	1925	1926	1927	1928	1929		Per cent	Lbs. per acre
Winter wheat Hybrid 128	(1)	(2)	2490	(2)	3048	2442	3252	3558	5	89.0	2698
Winter barley White winter	(1)	(2)	2400	(2)	2870	2530	2318	(3)	4	76.7	2326
Spring wheat Jenkin	1194	2640	2340	3810	4308	2868	3678	3420	8	100.0	3032
Spring barely Blue	1080	2568	1973	4238	2918	2429	2400	2237	8	81.8	2480
Oats Banner	1440	2061	2326	3488	2890	2579	2589	2080	8	80.2	2432

(1) Winter cereals followed alfalfa. Yields were omitted because they were not comparable with those of spring cereals.
(2) No yield of fall sown cereals were obtained.
(3) No winter barley varieties were grown in 1929.

This table confirms the general farming practice in that it shows spring wheat to be the most desirable cereal crop so far as the amount of feed produced is concerned. Winter wheat and barley are crops which are not grown extensively under irrigation. Experience with winter barley has shown that it winter kills to such an extent that it is not a safe crop. The yields of winter wheat have compared rather favorably with those of spring wheat in years when winter wheat produced a crop. However, in two years of the eight reported it was a total loss. Winter wheat is grown to some extent when it can be sown fairly early. It is used on sandy soil which blows badly during the spring winds, and it is sometimes grown for early spring pasture. Very little oats and barley are grown as cash crops, but many farmers grow enough of these cereals to feed their livestock.

Varietal Investigations of Cereals

The varietal trials with cereals were started in 1922 and have been continued each year since that time. Varieties chosen at the beginning of the experiment were selected for one of two reasons: (1) The probable adaptability of the variety to conditions under irrigation; or (2) the commercial importance of the variety. From the standpoint of the farmer on irrigated land the first reason might seem the only basis for selection but from a scientific standpoint of determining the reaction to

irrigation of widely grown varieties, such as Turkey, Marquis and Baart, the latter is important. The varieties added since have been chosen as having a possible place under irrigation.

In planning the work with cereal varieties it was thought desirable to use fields which would regularly be cropped with some cereal. Corn or potatoes usually follow alfalfa in the rotation system and cereals usually follow two or more years after the fields have been in alfalfa. All the fields which were used for the cereal varieties had previously grown alfalfa in the rotation system except the field which was used for spring cereals in 1922. The use of different fields for the trials also increased the accuracy of the results obtained. It so happens that the cereal varieties have never been grown twice on the same field. Figure 1 shows part of the cereal plots in 1927.

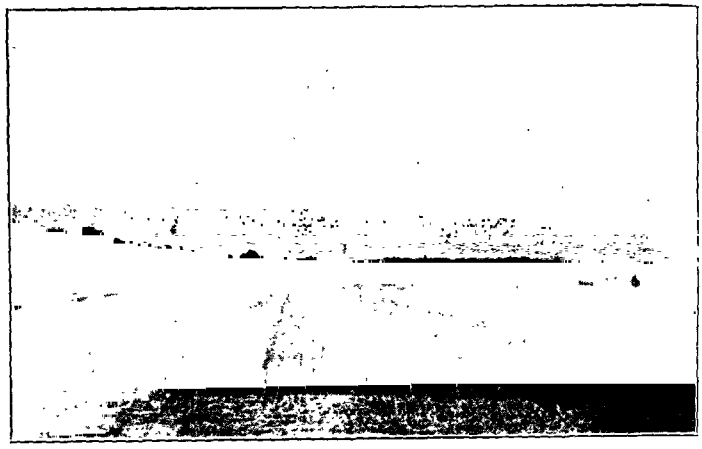

Fig. 1. Varieties of spring cereals in 1927.

The discussion regarding varieties will cover all the cereals which have been grown at the Station. The bushel weights which were used in computing yields were, wheat 60 pounds, barley 48 pounds, and oats 32 pounds per bushel.

Winter Wheat and Barley. ..Twelve varieties of winter wheat and three of winter barley have been tested. In 1923 no yields were obtained on account of severe wind damage to the young plants in March

The 1925 crop winter killed to such an extent that only survival data could be obtained. Therefore yield data are available for six years only. These data are presented in Table 2.

Table 2. **Average Annual Yields of Winter Wheat and Barley Varieties, Also the Comparative Production of Each using Hybrid 128 as a Standard for Wheat and White Winter for Barley**

Name of variety	Wash. No.	Average yield of grain in bushels per acre						Comparative production	
		1922	1924	1926	1927	1928	1929	Per cent	Bu. per acre
Wheat									
Triplet	597	37.1	37.6	53.8	51.0	60.5	50.5	100.9	48.4
Turkey	326	38.2	38.7	54.0	41.5	55.3		99.6	47.8
Ruddy	598	36.0	44.0	60 5	48.0	58.3	51.0	103.4	49.6
Hybrid 123	593	40.5	39.9	58.5	42.8	59 5	55.2	103.0	49.4
Hybrid 128	592	41.4	41.5	50 8	40.7	54.2	59.3	100 0	48.0
Jenkin	526	23.4	37.4	69.8	46.1	48.3	48.0	94.8	45.5
Hybrid 143	590	36.2	40.4	53.5	37.3	53.2		96.5	46.3
Ridit	2324			52.5	39.3	53 5		99 7	47.9
Albit	2515				41.0	52.2	52.5	94.5	45.4
Jones Fife	371	35.1	33.4	48.7	34.3			86.9	41.7
Fortyfold	351	26.8	27.0	43.0	39.0			77.9	37.4
Red Russian	270	27.4	37.8	57.1	40.7			93 5	44.9
Barley									
White Winter	957	54.2	50.0	59.8	52.7	48.3		100.0	53.0
Maryland	949	39.4	31.5	42.5				69.1	36.6
Chevalier	971	32.8	31.1					61.3	32.5

Hybrid 128, the standard used, was out yielded slightly by Hybrid 123, Ruddy and Triplet. Hybrid 128 is a white club wheat having a stiff straw and is very winter hardy. Hybrid 123 is also a club wheat but has red kernels. Both of these Hybrids have white glabrous chaff and are awnless. Ruddy is a soft red wheat of poor quality and its yield is not sufficiently higher than that of Hybrid 128 to justify its use. As a parent for new hybrid varieties it has possibilities because of its vigor. The pubescent chaff of Triplet makes it a less desirable variety than those which have glabrous or smooth chaff and which yield equally well. Ridit and Albit, two hybrids which are very resistant to some of the forms of smut, are both close to Hybrid 128 in yield. Ridit has a long head, white chaff and hard red grain. In apparance Albit very closely resembles Hybrid 128. Jenkin is much less winter hardy than the true winter varieties and therefore is not recommended for fall sowing.

Seed of Hybrid 128, Albit, Ridit or Hybrid 123 can be readily obtained from growers in the wheat sections of Washington. These four varieties are hybrids which were developed at Pullman by the Experiment Station at the State College. Seed supplies can usually be located by writing to the Agronomy Division of the Agricultural Experiment Station, State College of Washington.

Only three varieties of winter barley were grown. Table 2 shows that White Winter is much the best of the three for fall sowing. However, it is not recommended that barley be fall sown because of the danger of winter killing.

Spring Wheat. Spring wheat is by far the most important of the cereals which are grown under irrigation. It is used extensively as a nurse crop for legume forage crops and also is widely grown alone, especially on the Wapato project and in Kittitas County. The comparative production of thirteen varieties grown at Prosser is shown in Table 3.

Table 3. Average Annual Yields of Spring Wheat Varieties, also the Comparative Production of Each using Jenkin as a Standard

Name of variety	Wash. No.	Average yield of grain in bushels per acre								Comparative production	
		1922	1923	1924	1925	1926	1927	1928	1929	Per cent	Bu per acre
Federation	1247	15.8	45.8	32.8	53.7	54.3	35.7	46.7	48.5	82.4	41.6
Baart	618	21.9	34.0	29.3	48.1	55.8	36.7	43.2	45.7	77.8	39.5
Marquis	576	17.4	36.0	27.8	45.3	48.0	33.7	43.8	47.2	74.0	37.4
Dicklow	630	23.6	43.7	37.8	59.0	67.5	39.8	53.2	56.7	94.3	47.6
Jenkin	526	19.9	44.0	39.0	63.5	71.8	47.8	61.3	57.0	100.0	50.5
Bluestem	265	23.2	38.0	36.0	52.5	53.0	38.7	50.8	47.5	84.0	42.4
Prolific								52.0	56.0	91.3	46.1
White Russian	2732								54.0	94.7	47.8
Federation	2733								50.0	87.7	44.3
Thompson Club	2734								53.7	94.2	47.6
Hybrid 123	593	16.1	36.8	33.9	53.8	59.3	36.5	51.2		82.8	41.8
Hybrid 143	590	14.8	24.7	31.6	59.7	53.8				77.5	39.1
Alaska	2738	17.9	32.8	27.6						76.1	38.4

Six of these varieties have been grown every year during the last eight years. Jenkin and Dicklow have consistently outyielded all other

varieties. In order to point out more clearly the relative production of the varities which have been grown every year since 1922 the placing of these varieties in regard to yield is shown in Table 4.

Table 4. **Annual and Final Relative Placing According to Yield of Spring Wheat Varieties which have been Grown each Year During the Experiment**

Name of variety	Placing according to annual yield								Total of placing	Final Avg. placing
	1922	1923	1924	1925	1926	1927	1928	1929		
Federation	6	1	4	3	4	5	4	3	30	4
Baart	3	6	5	5	3	4	6	6	38	5
Marquis	5	5	6	6	6	6	5	5	44	6
Dicklow	1	3	2	2	2	2	2	2	16	2
Jenkin	4	2	1	1	1	1	1	1	12	1
Bluestem	2	4	3	4	5	3	3	4	28	3

It will be noticed that Jenkin has ranked first in six of the eight years. In both 1922 and 1923 the sowing was done late and Jenkin was handicapped by a short season for vegetative growth. Dicklow has ranked second or higher every year, except in 1923, when it was third. The consistent high placing of these two varieties indicates that they are much better adapted to the conditions which are found in the lower Yakima Valley, than any other variety shown in Table 4. The eight year average yields of these varieties are 50.5 bushels per acre for Jenkin and 47.6 for Dicklow. The next ranking variety produced only 42.4 bushels or more than 5 bushels less wheat per acre than Dicklow.

In 1929 several strains of wheat, known locally as White Russian or Thompson Club, were grown in the nursery in triplicate rod rows and two strains were grown in field plots. No difference in morphological characters or yield could be distinguished between the two but they were decidedly different from any other variety in the experiment. In the following discussions the name White Russian only will be used for this wheat.

The 1929 average yield of the two strains of White Russian which were grown in the field plots was within 3 bushels of Jenkin and was higher than that of all other varieties which have been grown for three

or more years except Dicklow. In the nursery the average yield of all strains of White Russian was 41.9 bushels per acre as compared with 47.4 for the average of the Jenkin check rows. The average yield for Dicklow was slightly less than for White Russian. In taking both field and nursery yields for 1929 into consideration Dicklow and White Russian seem to be of about equal value when sown early in the season. Jenkin, Dicklow and White Russian are the most widely grown wheats under irrigation in the lower Yakima Valley.

A large acreage of Federation is grown in Kittitas County. Since this variety has been one of the poor yielders at the Station it was decided to carry on cooperative work with the County Agent of Kittitas County to determine; first, whether the Federation grown in Kittitas County is the same as that used at the Station and second, the relative value of various wheat varieties under Kittitas County conditions. A strain of Federation which the County Agent selected as being representative of that grown in the county was included in the trials. It was also grown at the Experiment Station.

Four cooperative trials were completed. The varieties used were Jenkin, Federation—(Wash. No. 1247), Dicklow, White Russian and Federation—(Kittitas County, Wash. No. 2733).

Triplicate rod rows of all varieties were sown in fields which were to be sown to wheat. The date of sowing for all rows was April 5 or 6. Varieties were cut by the County Agent as they ripened and sent to the Experiment Station where they were threshed and weighted. Table 5 shows the results of each trial and the average for all of them.

Table 5. Average Yield of Five Spring Wheat Varities on the Farms of Four Cooperators in Kittitas County

Name of variety	Wash. No.	Average yield in bushels per acre				Average for all
		Name of cooperator				
		T. R. Jacobson	W. J. Payne	M. Lerfal	S. Woodhouse	
Jenkin	526	31.9	60.4	44.7	45.1	45.5
Federation	1247	29.4	49.6	47.9	41.2	42.0
Dicklow	630	27.0	58.6	55.5	33.8	43.7
White Russian	2732	27.6	49 6	57.0	31.5	41 4
Federation	2733	34.5	49.8	39.2	40.6	41.0

Results with two strains of Federation in these cooperative trials and at Prosser, in both the varietal trials and the date-of-sowing experiment, indicate that there is very little difference between them.

In computing the yields no allowance was made for shattering. Very little shattering trouble is experienced at the Experiment Station and it was not anticipated in planning the work in Kittitas County. In a letter regarding this problem the County Agent wrote the author as follows: "Shattering was greater in the Federation plots than in the other plots, and several times as serious as in the fields of Federation surrounding the plots. The difference in shattering of Federation plots and the field was greater than the greatest average varietal difference in the plots. During the winds the taller growing Jenkin and Dicklow beat the heads of Federation, causing them to shatter long before they were ready to cut".

Even if allowance is made for shattering the yielding ability of Jenkin and Dicklow must be recognized. The date of sowing, in early April, which would be considered late in the lower valleys, is considered fairly early in Kittitas County. If the sowing could have been done a month earlier the difference in favor of Jenkin would probably have been larger. However, most of the wheat in Kittitas County is sown in April and it is doubtful whether Jenkin should be recommended for sowing at that time. The early maturity of Federation and its short straw, which is a desirable characteristic in resisting shattering, are probably the reasons Federation has gained such a strong foothold in Kittitas County.

Description of Leading Spring Wheat Varieties. Jenkin is a late maturing tall wheat. It has an awnless, glabrous, club head with red glumes and white kernels. Dicklow is somewhat earlier maturing than Jenkin but grows about as tall. It has an awnless, glabrous, long head with white glumes and white kernels. White Russian is similar to Dicklow in growth except that it is a few days earlier. It has an awnless, glabrous, long head with white glumes and extra large white kernels. The head is somewhat clavate and has a few apical awns. Federation is an early-maturing, short-strawed wheat. It has an awnless, glabrous, long head with red glumes and white kernels.

Oats. During the time the varietal investigations have been under way, seven varieties of oats have been tested. Table 6 gives the results with each variety for the years it has been grown.

Table 6. Average Annual Yields of Oat Varieties, also the Comparative Production of each Using Banner as a Standard

Name of variety	Wash. No.	Average yield in bushels per acre								Comparative production	
		1922	1923	1924	1925	1926	1927	1928	1929	Per cent	Bu. per acre
Banner	764	45.0	64.4	72.7	109.0	90.3	80.6	80.9	65.0	100.0	76.0
Victory	1028	43.7	61.2	73.1	96.2	105.9	70.6	79.1	75.4	99.6	75.7
Markton	2088			78.3	106.9	88.1	78.1	85.0	72.7	102.1	77.6
Sparrow-bill	741	42.3	55.0	73.5	113.1	72.2				93.4	71.0
Abundance	759	41.9	60.2	76.8	114.4	87.2				99.8	75 8
Swedish Select	662	43.1	46.2	72.0	99.0	72.2				87.2	66 3
Sixty Day	661	31.3	37.7	53.5						67.3	51.1

The leading varieties of oats which have been grown at Prosser are Banner, Victory and Markton. The difference in yield for these varieties are slight but Markton has a decided advantage over the other two in that it is immune to covered smut, *Ustilago levis,* thus eliminating the expense of seed treatment.

Barley. The quantity of barley grown under irrigation in Washington is somewhat higher than that of oats. Usually the seed is bought and sold as beardless or bearded barley and very little attention is given to variety. However, there are decided differences in the yielding ability for some of the varieties. Table 7 shows the annual yield of the varieties which have been grown at Prosser, also their comparative production

Table 7. Average Annual Yield of Spring Barley Varieties, also the Comparative Production of Each Using Blue as a Standard

Name of variety	Wash. No.	Average yield in bushels per acre								Comparative production	
		1922	1923	1924	1925	1926	1927	1928	1929	Per cent	Bu. per acre
Beldi Giant	967	22.2	46.4	40.4	82.5	63.7	47.9	45.0	51.9	96.8	50 0
Blue	973	22.5	53 5	41.1	88.3	60 8	50.6	50.0	46.6	100.0	21.7
Horsford	873	16.1	39.6	41.0	76.4	44.4	43.3	42.7	44.1	84.1	43 5
Trebi	1176		46.0	38.9	78.7	75.0	60.4	46.0	52.2	101.5	52 5
California	970	20.3	47.7	43.7	74.6	56.0				91.0	47.0
Mariout	2571					64.8	46.7			100.1	51 8
Mariout	2572					66.7	44.6			99.9	51 6
Mariout	1175	26.1	39.7	30.1	48.7					70.4	36.4
White Winter	957	19.4	32.2	36.4	71.4	65.4				84.4	43 6

Beldi Giant, Trebi and Blue are all high yielding varieties. They are all bearded and are six-row type. Seed of all these varities can be obtained commercially. Horsford is the only beardless variety which was grown. However, its low yield makes it less desirable than the bearded varities, except for farmers who particularly want to grow a beardless barley.

Soil Fertility

All work on soil fertility for cereal crops has been with wheat. However, the results are applicable to all cereal crops grown under irrigation. The effect of growing wheat on soils of low and high fertility has been distinctly shown in a fertilizer experiment which was started on virgin soil in 1922. Nitrogen in various forms has been annually applied to various plots in a sufficient quantity to produce large crops. Check plots have been maintained for comparison. A three-year rotation of potatoes, corn and wheat was used.

Fig. 2. Jenkin wheat on one of the check plots in the fertilizer experiment. 1927 Yield 19.3 bushels per acre.

The difference in the yield of Jenkin wheat in 1927, the sixth year of the trials, ranged from 18 bushels per acre for the average of the check plots, to 67.3 bushels for one of the plots receiving nitrogen in the form of a good organic fertilizer. Figures 2 and 3 show these plots just before harvest. One plot receiving an inorganic fertilizer produced 57.7

bushels per acre. The fact that plots receiving a nitrogen fertilizer, either organic or inorganic, produced over three times as much grain as the check plots emphasizes the desirability of having good fertile soils for cereal production as well as for other crops.

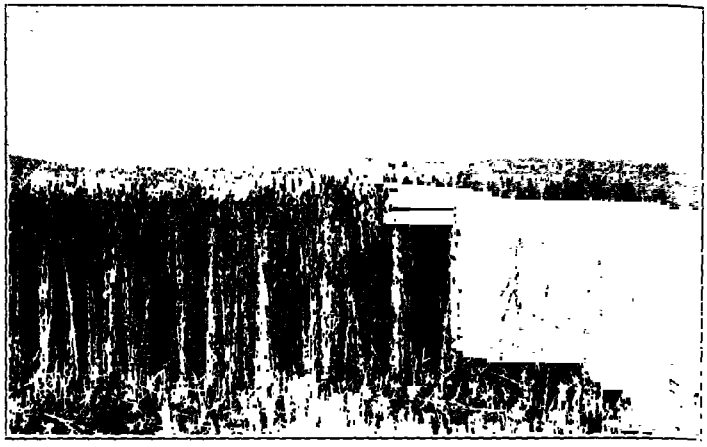

Fig. 3. Jenkin wheat on one of the fertilized plots in the fertilizer experiment. 1927. Yield 67.3 bushels per acre. This picture was taken the same day as Figure 2.

Since nitrogen is at present the element most often found deficient in our irrigated soils, it must be supplied before high yields of cereals can be obtained. The frequent use of forage legume crops in the rotation system will take care of the nitrogen supply. This may be illustrated by the yield of Jenkin in such a rotation. The average yield of this variety for the years 1925-1929 in the varietal trials has been 60.3 bushels per acre. So far as plant growth and yield are concerned the nitrogen could be supplied in the form of commercial fertilizers but the growing of legumes is a much more practical and economical means of accomplishing equal or better results.

Time of Sowing

The time of sowing cereals varies from the time spring work begins, which is usually in February or early March, until May. As a rule, the highest yields are obtained when the cerals are sown fairly

early. Cereals are frequently sown as early as February at the Irrigation Branch Experiment Station. During the last six years the varieties have never been sown later than March 15.

In order to determine the effect of the time of planting upon yield, a date-of-sowing trial with several varities of wheat was started in 1929. Five different plantings were made at intervals of about 10 days. Table 8 gives the results.

Table 8. Average Yield per Acre for Spring Wheat Varieties When Sown at Different Dates

Name of variety	Wash. No.	Average yield in bushels per acre when sown				
		Mar. 12	Mar. 23	Apr. 2	Apr. † 12	Apr. † 26
Federation	1247	43.2	29.2	34.4	31.9	28.0
Federation	2733	41.4	38.7	34 1	30.3	30 9
Jenkin	526	45.2	44.2	30.3	33.4	25.4
Federation	2735	39.8	33.7	31.9	29.5	31.0
White Russian	2732	38.1	37.8	31.0	35.0	31.7
Improved Dicklow	2641	38.5	34.1	36.2	31.5	32.6
White Russian	2736	45 9	40.2	38.3	37.8	39.7
Dicklow	630	39.2	43.0	31.3	35.6	29.0
Thompson Club	2734	43.3	38.7	33.5	37.9	36.0
Thompson Club	2737	41.1	37.1	37.3	37.3	30.1
Average for all varieties		41.6	37.7	33.8	34 0	31.4

† Irrigated before planting.

Although this table presents data for one year only, it brings out the fact that all our more important wheat varieties reach their highest production when they are sown early. An average difference of 10 bushels per acre between the first and last date of sowing is significant. Wheat is a plant that must tiller profusely in order to reach its highest production and early sowing allows more time for tillering during the cool weather of early spring. Under most conditions on irrigated farms wheat should be sown as early as the land can be properly prepared.

Seed Treatment

All wheat, oats, and barley which is to be used for seed should be treated with some good fungicide to control seed-borne infection, unless the variety is known to be immune or very resistant to smut. Two effective fungicides are formaldehyde for wheat, oats and barley; and copper carbonate for wheat only.

The formaldehyde treatment, 1 pint of formaldehyde to 40 gallons of water, will control bunt or stinking smut of wheat; covered and loose smut of oats; and covered smut of barley. The seed may be dipped in half sacks and should be kept in the solution for 10 minutes. It can be sown as soon as it has dried sufficiently to handle in the drill.

The copper carbonate treatment is preferable to formaldehyde for wheat but it is not effective for oats or barley. About 3 ounces of copper carbonate dust are thoroughly mixed with each bushel of seed wheat. When this method is used there is no danger of seed injury or retarded growth, the smut control is equal or better than with formaldehyde, and the seed may be treated at any time and stored until it is needed.

Rate, Depth and Method of Sowing

The rate of sowing cereals in irrigated sections is usually higher than under dry-land conditions. No experimental data are available at the Irrigation Branch Experiment Station regarding this problem. The practice of the successful growers and the general experience at the Station indicate that sowing two bushels of wheat per acre and about 100 pounds of oats or barley gives a satisfactory stand and a good crop. Some growers use more seed with satisfactory results. If used as a nurse crop the rate of sowing for each cereal may be reduced profitably to between 50 and 75 per cent of the regular rate.

Spring cereals give best results when they are sown fairly deep The usual depth at the Station is from 2½ to 3½ inches. Sowing should be done with a drill if possible. The depth can be controlled and the seed is evenly distributed. The seed-bed should be well prepared, moist and fairly firm. After sowing is completed a rolling packer will firm the soil around the seed.

Irrigation

Cereals are probably the lightest users of water of any of our irrigated crops. As a rule they are sown in spring moisture and are not irrigated until the plants are three or more inches tall. Irrigation water is usually applied three or four times. Since cereals ripen early the water is released for other crops during the latter part of the summer.

If cereals are to be sown late it is essential that the land be irrigated before planting. The general experience of farmers who have tried to irrigate cereals before the plants have emerged has been that it resulted in a very light yield. If the soil is thoroughly irrigated before the seed is sown, the young plants will be well established before irrigation is again necessary .

As soon as the cereals are sown and the soil packed the ditches should be made. With the seed at a good depth it is not disturbed and a uniform stand over the whole field will be secured. If ditching is delayed until the plants emerge some of the rows will be dug out and the adjoining rows will be covered with soil.

The ditching can be done with a single ditcher but a two or three-row ditcher does better work at less cost. A discussion of ditchers may be found in Washington Agricultural Experiment Station Popular Bulletin No. 145 "Units of Measurement and the Application of Irrigation Water", by C. C. Wright.

Although cereals do not require as much water as some other crops they do respond to good treatment. The time of application of water will depend upon the moisture supply in the soil and may be determined to some extent by soil examination but probably better by the condition of the growing crop. In no case should water be withheld until the plants have begun to suffer.

In order to show something of the effect of irrigation upon the crop an experiment has been carried on at the Irrigation Branch Experiment Station by C. C. Wright, Irrigation Specialist. Two years average results are given in Table 9.

Table 9. **Average Yield of Jenkin Wheat for Two Years When Irrigated with Various Amounts of Water**

No. irrigations	Total water used acre inches†	Average yield in bushels per acre		
		1928	1929	2 year
2	8	36.0	25 5	30 7
3	12	44.0	33.2	38 6
4	24	51.0	29.1	40 0

† The water applied was measured at the field. The runoff was also measured and this column represents water which was actually held by the soil.

If conveyance losses to the field and the runoff are included the 12 inch application amounted to about 18 inches. This is approximately the amount applied for cereals on the sandy loam soils of the lower valleys. An additional 6-inch application resulted in some increase in yield but not proportional to the amount of water applied.

Other crops such as alfalfa, sweet clover and potatoes need periodic irrigation throughout the entire growing season and may require as much as 4½ acre feet for good production. Thus the growing of cereals on part of the farm allows more water for these crops.